

## **Across the Cosmos January 2025: The Vera Rubin Observatory, Dark Energy, and Participatory Science**

The first national observatory to be named after a woman<sup>1</sup> is expected to commence science operations this year. There are so many things to say about this incredible facility that it's hard to know where to begin! Perhaps the best place to start is with the observatory's namesake, astronomer Dr. Vera Rubin. Dr. Rubin's observations of the rotation curves of galaxies provided convincing evidence for the existence of dark matter,<sup>2</sup> a discovery that earned her the National Medal of Science in 1993.<sup>3</sup> Understanding the nature of dark matter, and the even more mysterious dark energy, is one of the principal science goals that the Vera Rubin Observatory (VRO) was designed to address.

So-called "dark energy" is thought to be responsible for the accelerated expansion of the Universe, which was discovered through careful measurements of the distances to exploding stars known as Type 1A supernovae. This discovery earned Saul Perlmutter, Brian Schmidt, and Adam Riess, the 2011 Nobel Prize in Physics.<sup>4</sup> A recent article that appeared in *Monthly Notices of the Royal Astronomical Society* suggests that dark energy may actually be an illusion.<sup>5</sup> Understandably, this article has garnered much media attention.<sup>6</sup> The authors propose that current observations may be better explained by relativistic effects that come into play due to the Universe's patchy structure.

The new study, which utilizes a catalogue that contains more than a thousand Type 1A supernovae, presents a compelling challenge to the Standard Model of Cosmology; however, more observations are required to distinguish between the competing models. The VRO, which is expected to increase the number of studied Type 1A supernovae from thousands to millions, may help settle the question.

It is worth noting that in the Standard Model, dark matter and dark energy account for 95% of the contents of the Universe. The modifier "dark" before "matter" and "energy" underscores our ignorance. Studies enabled by instruments like the VRO may bring on paradigm shifts that raise entirely different questions about the nature of the Universe... and that's what makes science so much fun!

Other VRO goals include enabling detailed studies of our Solar System, the Milky Way, and monitoring diverse objects that change position or brightness over time. The VRO is expected to gather about 20 terabytes (i.e., one trillion bytes!) of data *per night* during its projected 10-year survey.<sup>7</sup> A collaboration between the VRO and Zooniverse will provide many opportunities for people of all ages and walks of life to become collaborators with

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<sup>1</sup> <https://rubinobservatory.org>

<sup>2</sup> <https://rubinobservatory.org/about/vera-rubin>

<sup>3</sup> <https://new.nsf.gov/honorary-awards/national-medal-science/recipient/vera-c-rubin>

<sup>4</sup> <https://www.aip.org/news/2011-nobel-prize-physics-accelerating-expansion-universe>

<sup>5</sup> <https://academic.oup.com/mnras/article/536/2/1752/7890815>

<sup>6</sup> See, for example, the short Universe Today podcast: <https://www.youtube.com/watch?v=YqYY8qV7v3s> or <https://scitechdaily.com/dark-energy-may-be-an-illusion-scientists-uncover-a-lumpy-universe/>.

<sup>7</sup> <https://rubinobservatory.org/explore/how-rubin-works/lst>

scientists by participating in the diverse research made possible – their website currently lists several projects related to VRO science that you can contribute to now!<sup>8</sup>

Until next month,

Grace

Grace Wolf-Chase (she/her/hers)

Senior Scientist; Senior Education & Communication Specialist

Planetary Science Institute

[gwolfchase@gmail.com](mailto:gwolfchase@gmail.com)

<https://www.psi.edu/staff/profile/grace-wolf-chase/>

Vice President, Center for Advanced Study in Religion and Science

([CASIRAS](#))

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<sup>8</sup> <https://rubinobservatory.org/explore/citizen-science>